4426/622

From: Deutsche Müller-Zeitung, No. 17, p.417-8

Is the powdery flour of the pneuma mills bakable?

By Franz Scheuch

In pneumatic mills, the material to be ground is conveyed with moving air, which supplies the material to the discharge across separators in thin steel or metal pipes.

The system has been described so thoroughly in our trade journal that nothing more need be said. Now, while the separation or gravity fall of the conveyed material is surprisingly high in these miniature separators, it is not one hundred per cent. A fine, powdery flour dust is entrained with the outgoing air and must be deposited on a common filter - usually a common large separator is inserted. The floury product which then results is frightfully fine and has the feel of steatite. According to the theoretical principles of the physics of flour, this powder should be completely unbakable, and I am quite sure that my colleagues will have had the same experience; they will have been upset about this product, which is usually collected in bags, when they first felt it. They did not know what to do with it. I tested the gluten yield. Also I tried to make a farinogram, and I was so surprised by what I found that I repeated the experiment.

This smooth, powdery flour is an outspoken gluten flour, and I determine a wet gluten content of 58.4%. Compared with the normal glutens of the drawn flours, this gluten has an excellent baking quality. However, we were using about 45% of Hard Winter I, the balance Red Winter II, obtaining in our type flours of an ash content of 0.71 on the average about 32.5% of good gluten in the moist state.

The ash content of the powder flour of the pneuma separation was higher - 1.068% in the drier.

Specific gravity

The specific gravity of this flour was unbelievably light, referred to one liter only about 280 gram, while our normal flour weighs some 510 gram per liter on the average. So I was in great trouble about accommodating the remaining 300 gram of this flour in the kneader of the farinograph. I finally succeeded, for also the water absorption (83.5%) was unbelievably high. The resulting curve showed a very good dough development and a very high dough stability or fermentation tolerance.

In short, the entire experiment showed abnormally high baking values and furnished the exact opposite of the previously generally held view that powdery, very smooth flours had lost their bakability. What may be the explanation of this phenomenon? To make this clear we must go a little farther and look into the history of nutrient incorporation in the cereal grain.

History of nutrient incorporation

Each individual grain forms in itself a nutrient shell or bowl, surrounded by a structural cell tissue which to this date is unattainable in its design. A bond of longitudinal and transverse, tubular and honeycomb cells protect the inner nutrient deposition from external influences. And laid to this manger, as it were, the germ waits in its slumber until moisture and warmth of the soil wake it up. But once awakened to life, the germ begins to develop stupendously. It takes food from the interior of this nutrient store. However, the white flour substance in the interior of the grain is not digestible by the germ in this form. Now in his wisdom and care the Creator has provided the germ with enzymes, which get into the interior of the grain with the moisture and there, as soon as the necessary moisture and heat are available, immediately begin their work of decomposition, transforming these high-molecular materials of the nutrient store into simpler forms.

Each organic substance form has its particular enzyme. The enzyme diastase, for instance, decomposes starch to maltose, and the enzyme maltase decomposes the maltose to liquid dextrose. The situation is similar with the proteins.

Here proteolytic enzymes are at work, decomposing the tissue layer of the protein walls and transforming them into soluble materials, which all seep toward the germ and nourish it until it has developed to the point where it can by its own force penetrate into the earth with its rootwork, pierce the earth toward the light with its sprout, and greet the sun with its green leaflet. At that time the germ has come to the end of its existence and the embryo has become an independent plant.

At that time, too, the last granule of starch and the last particle of protein has been completely decomposed and consumed by the germ. All that remains is the outer shell of cellulose, which is now burst by the rootwork of the germ and disintegrated by the soil bacteria.

Understanding this process correctly, we see immediately why germination-containing cereal has for the most part lost its bakability. Due to the decomposition of the high-molecular substances in the gluten and starch, the structure has become weakened, especially in the gluten which is what holds the contents, so that it is unable to retain the gas formed during fermentation in bread-making.

Growth of the cereal plant

Let us now sketch the life of the young seedling. Having become an independent plant, it must draw its nourishment from the small piece of ground in which it is rooted and from the air which sweeps it.

From the air it takes carbon dioxide, which it draws in through gaps in its foliage, transforming it into dextrose under the action of sunlight and with the aid of the chlorophyll contained in the green leaves. This process is called assimilation. The dextrose flows through the cells of the plant and is built up further to starch, deposited in the ripening seed as tiny starch granules, or to cellulose, used for the construction of new cells. It is miraculous to see this construction work of the plant, and the more we delve into this matter, the more we must with awe and humility incline our heads before the wonders of the creation. While we can surmise how all these

processes of composition and decomposition take place in the vegetable world, we are unable to copy it from the plant in spite of all our knowledge in chemistry and physics.

The proteins consist of the same basic materials as starch, except that the proteins further contain nitrogen, while the carbohydrates - and they include starch - are nitrogen - free. As we all remember from our school days about 4/5 of the air is nitrogen. Yet the cereal plant cannot utilize this atmospheric nitrogen. It must absorb it in the soil water, which it pumps up from the earth by means of its rootwork and the fine root tubules according to the law of capillarity, to the most remote cells of its structure. Certain saltpeter salts, which owe their origin to the activity of certain soil bacteria, have an important part to play here.

These so-called nitrifying bacteria are nearly always able to transform the protein and ammonia nitrogen put in the soil as fertilizer into the nitrates readily absorbable by the cereal plant. The nitrogen salts dissolved in the soil water are sucked up by the plant and distributed over all the cells of its structure. With the aid of the carbon dioxide absorbed from the air and with the pumped up soil water the workshop of plant growth then produces, by a very complicated process, the amides, which are important for the further composition of the protein. The amides are further condensed to amino acids, regarded as the actual building blocks of protein. The latter are then transmitted from cell to cell in dissolved form, similarly as the dissolved carbohydrates, until they finally diffuse into the growing cereal grain, depositing there with further upgrading transformation as materials of high and extremely high molecular weight.

This reserve material deposition of the protein, in which we as millers and bakers are most interested, takes place in a form that the last stage of protein deposition occurs with the formation of an extremely fine-walled continuous tissue, resembling a honeycomb, whihh it secures with deposited starch granules and envelopes with a network, as it were. Between the individual walls

of this protein tissue - which spreads more or less densely over the entire internal flour material of each single cereal grain, and this in such a way that the density of the tissue decreases toward the interior of the grain while it is densest at the outer layer-there are tiny cavities which during the growth of the grain are filled with water. (Concordant view of various researchers)

Ripening time

In the course of the last development and ripening, but in particular during the subsequent or secondary ripening, most of the water evaporates, so that in normal crop years our domestic cereals have a moisture content within the range of 15-16% moisture.

As the cereal is treated in the mill, at which time the inner flour material is disintegrated, this reserve material deposition is detached from the shell of the grain and broken up into microscopically small particles. This, then, is our flour, formed from particles of the inner flour material and composed therein out of tiny starch granules with equally small or still smaller fragments of the gluten protein tissue by grinding.

Since starch has a higher specific gravity than the protein particles, we have a very good explanation for the initially mentioned observation of the extremely high protein or gluten content in the powdery flour of the pneuma separator. These light, extremely finely divided protein particles of the gluten tissue simply fly on with the discharged air and are recovered by themselves only in theseparator or in the filter. This is the only explanation for the high gluten content and the very high water absorption of this powder flour of the pneuma mill. The separation, of course, is in such small amount that there can be no detriment to the bakability of the normal flour. Moreover, it is perfectly all right to admix this extremely fine flour to the baking flour. It suffices to check if the separation is free from specks. And this is the case in a correct installation. But then there is another aspect. There is more and more call for aleurone flours for the production of bread for diabetics.

here we would certainly have a flour which would meet these requirements, and many a customer could be helped out of his predicament in this way.

(Translated by Carl Demrick/LH)